Application of a Two-Dimensional Residual Mean Meridional Circulation Calculated from an Inversion Algorithm Perspective

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Calculation of circulation fields in a two-dimensional global model is complicated by the near cancellation of the mean circulation and the eddy circulation. In this context, the mean circulation represents the zonal average fields and the eddy circulation is a result of departures from the zonal means. To avoid the complications of near cancellation, the residual mean meridional circulation (RMMC) is often calculated directly. This residual mean or diabatic circulation has also been widely used in the analysis of satellite observed temperature and trace gas concentration fields.

Instead of using the thermodynamic equation with known heating rate and circulation fields to calculate the evolution of the potential temperature distribution, the circulation fields are instead calculated from known temperature and heating rate fields. At first inspection, this may seem to be an arbitrary but numerically equivalent choice. However, because the circulation fields are constrained by conditions not pertinent in calculating temperature fields, these are considerably different numerical problems. The purpose of this paper is to expand upon these differences, present a algorithm for calculation of the RMMC derived from inversion theory, and to present circulation fields and resulting ozone distributions resulting from application of this algorithm within the LLNL two-dimensional chemical-radiation-transport model. The inversion approach is advantageous in regions in which the temperature gradients are small or when it is desirable to apply other *a priori* constraints. We present results of using such constraints to enforce the appearance of circumpolar vortices and subtropical pipes in the upper-troposphere and lower stratosphere.

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